SCIENCE

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THE PHOTOCHRONOGRAPH.

THE observations described and discussed in a recent publication of the Georgetown College observatory had their origin in a visit made by Professor Frank H. Bigelow and Mr. G. Saegmüller to that observatory in the summer of 1889. Their object was to use the observatory's five-inch equatorial for a series of experiments in photographing star transits. All the resources of the observatory were most cordially placed at their disposal by the director, the Rev. J. G. Hagen, and on Aug. 12, 1889, the first apparatus was tested.

The experiments were repeated on Aug. 26 with an improved apparatus, and were then broken off, for the time being, by the appointment of Professor Bigelow to the West African eclipse expedition.

The purpose of the method of observation described is the removal of the "personal equation" in transit observations, by means of photography. One night, Professor Bigelow, to whom the idea is due, and Mr. Saegmüller, an instrument-maker of Washington, were sitting with the director of the observatory at the table in the library, and consulting as to the best way of putting the idea to a test. The long focus of the equatorial and the electrical connections for the time-signals and incandescent lamps came in very handy for the purpose. The first camera was soon constructed and screwed to the eye end of the telescope, and a few evenings later the star Alpha Aquilæ was made to trace its diurnal motion on a small plate not quite two inches square, while the siderial clock made the whole camera move in a vertical direction once every second. Finally, the spider-lines of the micrometer were photographed on the same plate by means of an incandescent lamp held for a few seconds before the object-glass. The development of the first plate, in the dark-room of the cellar, was watched with great expectation, and, to the satisfaction of all the bystanders, brought forth two parallel trails, broken into dashes, each representing a second of time, and the whole reticule of the micrometer lines. The first apparatus was soon superseded by a second, and the second by a third, each being improved as the experiments suggested.

Shortly afterward Professor George A. Fargis was attached to the observatory, and at once put in charge of the Ertel transit-instrument. The "photochronograph" in its present shape, and and the improved method of photographing the reticule wires without injury to the star-trails, are entirely his inventions.

The principal idea in photographing the transits of stars is to translate the phenomenon of an object moving over the field of view in a telescope — the instant at which it passes a thread being noted by eye or ear, or by the chronograph — into a picture of the same which can be measured leisurely as a fixed object. The error of the personal equation depends ultimately upon the difference of time required by the eye to receive the impression of a bright object and to let the same go. Impression is more rapid than the letting go, and the relative times of retention vary with individuals, and with the variable physical condition of the individuals. As stars are momentarily occulted behind a thread in transit, this element of retention throws the apparent place of the star beyond the thread; hence eye and ear observations, being taken at intervals *from* the thread, with the star in full vision, are more accurate, and need a positive correction usually to be reduced to transits by chronograph taken *on* the thread.

A photographic plate reduces to a minimum this correction, both as to its amount and its variability; and whatever other corrections may be introduced by the process, they are mechanical and can be obtained by the discussion of results.

For the work of making a standard catalogue of bright stars for fundamental differential comparisons, for longitude determinations, for latitude, and also for physical observations in laboratories, it seems very important to eliminate by some process the error of the personal equation, which is in fact the greatest source of error in all such measures.

The first experiments to determine time by photographs of star transits were made by Professor E. C. Pickering, at the Harvard College observatory, in January, 1886, the account of the work being given in the Memoirs of the American Academy (Vol. XL., p. 218).

The star images of the Pleiades were allowed to trail over a sensitive plate, the eight-inch Bache telescope being used, for known intervals of time. It was found that microscope settings on the marks could be made with a probable error of only $0^s.03$, thus indicating the possibilities opened up by the method.

It now remained to apply it to transits in some way available in accurate reductions. There are two steps to be taken: (1) that which should connect the star trail definitely with the astronomical clock; (2) another enabling the transit to be referred to the collimation axis of the telescope. Both must be simple, and free from all important objections. At the suggestion of Professor Pickering and Mr. Willard P. Gerrish, it was, in the summer of 1888, at the Harvard College observatory, attempted to solve the first in the following way. A small plate was attached to the armature of a magnet by which a movement up and down, perpendicular to the star trail through a very small interval, could be communicatad to it by making and breaking the circuit at fixed intervals, either by hand or by the clock, the latter requiring a commutator in which the makes and the breaks should be of equal lengths. The effect was to leave on the plate a pair of dotted lines close together, the dots alternating in the perpendicular direction. The beginnings of the intervals and the endings were definitely marked, and settings of a micrometer thread could be made on them very accurately, the probable error being not greater than $0^s.02$ in second-intervals.

Professor Bigelow constructed an apparatus for testing this process, the plate being kept in a paper-holder inserted in a slide attached to the rocking armature which responded to the currents in the magnet. The telescope used was the eight-inch equatorial and the current was made and broken by hand. In the autumn Mr. Gerrish constructed a commutator by which the clock made the motions of the plate automatically.

Omitting for the moment mention of the second part of the process, for the sake of the chronological order, the next piece of apparatus was constructed by Mr. Saegmüller of Washington D.C., at the suggestion of Professor Bigelow, and was tried a few nights at the Georgetown observatory in the summer of 1889 by the kindness of the director, the Rev. J. G. Hagen. This piece embodied an important improvement, while retaining the alternating motion of the plate. A frame was made to carry a small plate-holder, which could be very readily interchanged with a common observing eye-piece. The star having been received into the field and adjusted by the direct vision, in five seconds the plate could be placed to receive the transit, this being a great practical improvement, as otherwise the adjustment of the star trail depended upon the finder to the telescope.

The eclipse expedition to West Africa, 1889, withdrew Professor Bigelow's attention from the subject, and further development devolved wholly upon the Georgetown College observatory.

Returning to the second division of the experiment, namely, the referring this trail to the middle wire and thence to the collimation axis of the telescope, without which the observation would be worthless, a number of combinations were discussed at the Harvard College observatory. Professor Bigelow's first experi-

ments consisted in using large threads which should interrupt the star trail by their own occultation of the star. This divided a continuous trail nicely, in two opposing cones of density, and was effective, but had obvious disadvantages for a transit instrument. Finally he found that by shining a light into the objective for two or three seconds, the whole plate could be fogged down without obscuring the dotted trail, which seemed only to advance in its density, while the lines behind the threads failed to be fogged, and, retaining the original density of the unexposed plate, received definite edges suitable for microscopic measures by bisection or parallelism of threads. Small threads, even the ordinary ones used in the transit reticule of observatory instruments, are amply distinct for this purpose, and this part of the process leaves nothing to be desired.

There is no doubt that in a six-inch transit instrument stars can be taken to the fourth magnitude, and wherever the elimination of personal equation is sufficiently important the utility of the method can hardly be doubted. It is believed, however, that the chief field of usefulness will be found in the physical laboratory, where any amount of artificial light can always be used, and the automatic record can be made to assume any degree of accuracy desirable. It is known that many experiments in physics are afflicted with personal equation, and thus there is a hope of avoiding them by the introduction of this apparatus.

NOTES AND NEWS.

THE Boston *Medical and Surgical Journal*, quoting an English medical publication, says that the theory has been more than once advanced that the origin of ether-drinking in Ireland can be traced to the success of Father Matthew's crusade against drunkenness in its ordinary forms. Alcoholic nature, driven out by his eloquence, returned in a new disguise, and the last state of the victims was as bad as the first. This theory has been called in question, but it receives accidental confirmation from what is at present happening in Norway. The sale of liquor is, in that country, encompassed about with more restrictions than that of the most deadly poison is with us. Temperance, in fact, is the law of the land in Norway. But these people, made sober by act of parliament, have now discovered how to get drunk without violating the law. Ether-drinking, according to a Norwegian contemporary, is becoming quite common in certain districts. The farmers buy it in considerable quantities, especially at Christmas time and on other festive occasions, and they treat each other and get drunk on ether, as they formerly did on potato or barley brandy. Ether is said to be drunk by young and old, men and women, rich and poor. If this be true, it seems to point a moral which perhaps thorough-going temperance advocates have not taken sufficiently into account. Is there, after all, a grain of truth in Byron's thesis that "man, being reasonable, must get drunk," and can the moderate use of ordinary stimulants be suppressed only at the risk of the evil spirit, which has been cast out, coming back after the house has been swept and garnished, bringing with him seven devils worse than himself?

— A correspondent of *Science-Gossip* writes to that periodical as follows: "A friend of mine keeps a quantity of fowls. They are the common kind, usually called, I think, 'barn-door fowls.' On Thursday, April 9, a number of eggs were collected. A few were given to the gardener. His wife boiled one for his breakfast on April 10, and when he cracked it a pin was found in the yolk. The yolk and white were, in places, of a blue-black color. I should feel obliged if any reader would inform me whether they have ever heard of anything being found before inside an egg, and how it got there."

— Bulletin No. 13 of the Experiment Station of the Iowa Agricultural College contains the results of a feeding experiment conducted by the farm and chemical sections. Corn fodder, corn ensilage, sorghum cane ensilage, and mangels were fed for sixty days to eight cows. The milk was sampled at every milking, and the composite samples analyzed every five days. The effect of the four different fodder rations was tabulated and results indicated from the butter fats and total solids produced by each ration, calculated from a dry matter basis. Corn fodder shows slightly better results than corn ensilage, which exceeds sorghum cane ensilage. The mangel ration is superior to any of the others. Clover hay was fed with all the rations, a double amount being given with the roots.

— A simple method of applying concrete under water has been used by the French engineer Heude in connection with the foundation work of the bridge over the River Loire, at Blois. As described in the *Railroad Gazette*, the concrete was deposited at the desired points by means of a wooden pipe composed simply of four boards and being about sixteen inches square in section. This pipe or tube was lowered vertically into the water, and was made of such length that when the lower end reached the bottom the upper end projected about five feet above the surface of the water. By means of suitable lifting tackle and scaffolding the tube could be easily raised and lowered, and moved from place to place as desired. The tube was filled with concrete, and, on being slightly raised from the bottom, the concrete could flow out and spread itself over the surrounding surface without previously coming into intimate contact with the water. By moving the tube about over any desired area, layers of concrete could thus be readily put down varying in thickness from twelve to sixteen inches. The only point to be specially observed was that the level of the concrete in the tube was always above the level of the water on the outside, thus maintaining a sufficient head of concrete to overbalance the tendency of the water to enter at the lower end of the tube. To secure this entire exclusion of water from the tube, the primary filling with concrete was accomplished after having first closed the lower end of the tube with a board; the tube having been filled this board was withdrawn. It is stated that with one such tube about eighty yards of concrete could be deposited per day, and that, in general, the results of the method were entirely satisfactory.

— The winter forcing of tomatoes is little understood by gardeners, and the literature of the subject is fragmentary and unsatisfactory. Yet it is a promising industry for all the older parts of the country, particularly in the vicinity of the larger cities, as winter tomatoes always find a ready sale at good prices. The crop is one which demands a high temperature, an abundance of sunlight, and great care in the growing, but the profits, under good management, are correspondingly high. Tomato forcing is one of the most interesting and satisfactory enterprises for the winter months. Careful experiments upon it during two winters, made at the Cornell University Experiment Station by Professor L. H. Bailey, have met with uniform success. Details of the experiments are contained in Bulletin 28 of the station named, dated June, 1891.

— The Census Bureau at Washington has issued a bulletin on the distribution of population in accordance with altitude. It appears that in the area less than five hundred feet above sea-level is included nearly all that part of the population engaged in manufacturing and in foreign commerce, and most of that engaged in the culture of cotton, rice, and sugar. Between five hundred and fifteen hundred feet above the sea are the greater part of the prairie States and the grain-producing States of the North-west. East of the ninety-eighth meridian 1,500 feet is practically the upper limit of population, all the country above that elevation being mountainous. Between 2,000 and 5,000 feet above sea-level the population is found mainly on the slope of the great western plains. Between 4,000 and 5,000 feet, and more markedly between 5,000 and 6,000 feet, the population is decidedly in excess of the grade or grades below it. This is mainly due to the fact that the densest settlement at high altitudes in the Cordilleran region is at the eastern base of the Rocky Mountains and in the valleys about Great Salt Lake, which regions lie between 4,000 and 6,000 feet. Above 6,000 feet the population is almost entirely engaged in the pursuit of mining, and the greater part of it is situated in Colorado, New Mexico, Nevada, and California. While the population is increasing numerically in all altitudes, its relative movement is decidedly toward the region of greater altitudes, and is most marked in the country lying between 1,000 and 6,000 feet above the sea. The density of population is greatest near sea-

level in that narrow strip along the seaboard which contains our great seaports. The density diminishes gradually and rather uniformly up to 2,000 feet, where the population becomes quite sparse. The average elevation of the country, excluding Alaska, is about 2,500 feet. The average elevation at which the inhabitants lived, taking cognizance of their distribution, was 687 feet in 1870; in 1830 it had increased to 739 feet, and in 1890 to 788 feet.

— The following is a brief report of the operations of the Geological Survey of Missouri during June. In the field, examinations of the clay deposits and other structural materials have been continued in Franklin County, and have been extended into Cooper, Morgan, Miller, Callaway, Gasconade, Jefferson, and Ste. Genevieve Counties. Preliminary inspection of coal beds have been made in Ray, Moniteau, Ralls, Putnam, and Grundy Counties, and lead deposits have been examined in Madison County. Detailed mapping has been prosecuted in Madison, Ste. Genevieve, Johnson, Ray, and Randolph Counties, and about 125 square miles have been covered. In the laboratory, analytical work has been done on some twenty samples of mineral waters, forty samples of coals, seven samples of limestone, and fourteen samples of clays. For the solution of problems of general stratigraphy and for the preparation of the report on the paleontology of the State, sections have been visited and collections have been made in Greene, Jasper, Newton, Lawrence, Ste. Genevieve, St. Louis, Clark, Marion, Pike, Lafayette, Saline, and Cooper Counties; and collections have been examined in Kansas City, Curryville, Sedalia, Clinton, and Springfield, Mo., and in Chester and Sparta, Ill., and in Burlington, Iowa. In the office, Bulletin No. 5 has been prepared, and is now in the hands of the printer, and much progress has been made in the preparation of the manuscript of Bulletin No. 6, which will consist of a preliminary report of the distribution of coal in the State. Mr. Frank L. Nason, late assistant geologist of the New Jersey Geological Survey, has been appointed to a similar position on the Geological Survey of Missouri, and will be in charge of the iron ores of the State. Professor Erasmus Haworth has resumed work for the summer on the crystalline rocks, and will also collect material for the preparation of a report on the mineralogy and petrography of the State. Professor C. H. Gordon has similarly resumed work for the summer in the coal fields, and most of his time will be given to the detailed study and mapping of the coal beds of Macon County. Professor J. E. Todd of Tabor, Iowa, has been engaged to take up during the summer the study of the quarternary deposits of Missouri, and to prepare a report thereon.

— The London *Journal of Education* intimates that M. Bourgeois, the French Minister of Public Instruction, is a bold bad man who has dared to run a tilt against the orthodox national spelling. In a circular addressed to rectors, he calls their attention to the waste of time that takes place in many schools in mastering the minutiæ of spelling, to meet the real or supposed exigencies of examiners. To lighten the burden of scholars and teachers, he lays down certain regulations for the future guidance of examiners. (1) Wherever authorities differ, admit all varieties — *rhythme* or *rythme*, *collège* or *collége*. (2) Where the accepted spelling is illogical, do not be severe on the logical pupil — e.g., the plurals in *x* like *genoux*, *apercevoir*, and *apparaître*. (3) Show the same indulgence with regard to the distinctions of recent grammarians — the plural of *cent* and *vingt*, the plurals of compound substantives, the agreement of *demi*. M. Bourgeois is no advocate of phonetic spelling, but he preaches a wide toleration. English spelling is far more anomalous and illogical than French. Is it too extravagant to hope that a similar instruction will be issued to inspectors from the education department, and that the reform may be spread to the civil service commissioners? There can hardly be any more demoralizing study than learning by heart the list of verbs in *-cede* and *-ceed*, and nouns in *-ence* and *-ense*. It is high time that this "fetish of orthography," to which our ploughboys and young officers are equally sacrificed, should be demolished. May we hope, too, that in time the revolution may affect the teaching of French, and that English schoolboys will not be required to know more than is demanded of natives? This, however, is a far-off divine event, and the French examiner for the joint board, or the London matriculation, will fight to the death for his *travails* and *œils*, his *mil*, *mille*, and *milles*, his *gardefu* and *gardeschasse*.

— A new botanical club has just been organized in Canada called the Botanical Club of Canada. The object of the club is to adopt means, by concerted local efforts and otherwise, to promote the exploration of the flora of every portion of British America, to publish complete lists of the same in local papers as the work goes on, and to have lists collected and carefully examined in order to arrive at a correct knowledge of the precise character of the flora and its geographical distribution. The following is a list of the officers for 1891–2: President, Professor George Lawson, Halifax; secretary and treasurer, A. H. Mackay, Halifax; secretaries for the provinces: Ontario, Professor John Macoun, Ottawa; Quebec, Professor D. P. Penhallow, Montreal; New Brunswick, George U. Hay, St. John; Nova Scotia, E. J. Lay, Esq., Amherst; Prince Edward Island, Francis Bain, Esq., North River; Newfoundland, Rev. A. C. Waghorne, New Harbour; Manitoba, Mr. Burman, Esq, Winnipeg; Alberta, W. H. Galbraith, Esq., Lethbridge; British Columbia, Dr. Newcome, Victoria.

— Professor H. Garman, entomologist and botanist of the Kentucky experiment station, reports in Bulletin 31 of that station a series of experiments in the application of Bordeaux mixture to strawberry plants for the prevention of leaf-blight, from which he draws the following conclusions: (1) Injury from strawberry leaf-blight can be largely prevented by the use of Bordeaux mixture and *eau celeste*, and to some extent by potassium sulphide and London purple. (2) Bordeaux mixture is much superior to the other preparations used. (3) Applications of Bordeaux mixture should be made as often as once in two weeks. From the complete exposure of the leaves to rain, the mixture is removed from strawberry leaves much sooner than from grape leaves or those of trees. (4) Prepared according to the following formula, it may be sprayed without the slightest injury to leaves: Bluestone, 6½ pounds; lime, 3½ pounds; water, 22 gallons. (5) Twenty-two gallons of the mixture is sufficient for spraying during one summer 337½ feet of strawberry plants, as commonly planted in rows; and will cost for materials, considering bluestone worth eight cents per pound, and lime worth one cent per pound, fifty-six cents. By buying materials in quantity, this cost can be reduced. (6) A removal of the blighted leaves in summer, without subsequent spraying, will increase instead of diminish injury from blight.

— The following notes on the home mixing of fertilizers, taken from the annual report of the Maine experiment station, are as applicable to some other states as to Maine. The mixing of fertilizers on the farm through the use of chemicals and raw materials does not seem to have been undertaken to any extent by Maine farmers, although it is clearly shown that intelligent farmers of other states, Connecticut for instance, are finding it profitable to adopt this method of obtaining commercial manures. During the year 1887 and 1888 the Connecticut experiment station examined twenty-one fertilizers mixed by farmers from chemicals purchased by themselves, and the analyses show: (1) That these home mixtures compared favorably in composition with the best factory-made fertilizers. (2) That the home mixtures had a satisfactory mechanical condition. (3) That the ingredients of the home mixtures cost the consumers on an average from 20 to 25 per cent less than if purchased in factory-made fertilizers, after allowing $3 per ton for the cost of mixing. It is not claimed that all farmers would find it profitable to mix their own fertilizers from chemicals, but it is believed that there are many farmers in the State so situated with reference to markets and transportation that they could buy and mix chemicals with profit. This could be better done, perhaps, by an association of farmers, so that by the purchase and transportation of large lots at one time, a saving could be made in prices and freights.

— A new medical sect has arisen in the West, and has already founded a college in the State of Washington, in which medicine is taught according to the biochemic doctrine, which according to

the Boston *Medical and Surgical Journal*, is thus described by one of the lecturers at a recent meeting: "The innumerable cells of the human body are supplied by twelve mineral salts in the blood, which, when their proper proportion is interfered with in any manner, cause diseases of different natures, according to which mineral salt is deficient or in excess of its natural ratio; that is, the disturbance of this ratio puts the human system into a proper condition to absorb the disease germs that are constantly floating in the air. By providing twelve specific medicines by which the proper proportion of mineral salts is restored, health is regained and disease driven out by furnishing direct to the blood the same molecules that a perfect digestion and assimilation would furnish. The doses administered supply to the tissue cells the special salt, the lack of which is the cause of all diseases. Under the advance of biochemistry it has become possible to apply to each kind of tissue its own definite and peculiar salt, according to the requirements in disease. By the distinctive systems our physicians are guided in the choice of the particular cell-salts required, the immense variety and numerous complications of morbid states offering vast scope for exact medical practice wherewith to build up the great pyramid of scientific medicine of this advanced era."

— An interesting account of the nest and eggs of the cat-bird (*Ailurœdus viridis* Latham), says *Nature*, is given by Mr. A. J. North in the latest number of the Records of the Australian Museum (vol. i., No. 6). The habitat of the cat-bird is the dense scrubs of the coastal ranges of New South Wales. Although the bird is common, authentic specimens of its nest and eggs seem to have been unknown until lately. For an opportunity of examining such specimens, Mr. North is indebted to Mr. W. J. Grimes, an enthusiastic oologist, who recently secured two nests of this species on the Tweed River. The nest is a beautiful structure, being bowl-shaped, and composed exteriorly of long twigs, entwined around the large broad leaves of *Ptarietia argyrodendron*, and other broad-leaved trees, some of the leaves measuring eleven inches in length by four inches in breadth. The leaves appear to have been picked when green, so beautifully do they fit the rounded form of the nest, one side of which is almost hidden by them. The interior of the nest is lined entirely with fine twigs. The eggs are two in number for a sitting, oval in form, being but slightly compressed at the smaller end, of a uniform creamy white very faintly tinged with green, the shell being comparatively smooth and slightly glossy. Although the cat bird is usually included in the family of bower-building birds, Mr. North has never known or heard of its constructing a bower.

— The following memorandum, by Sir George Birdwood, on the myth of the second birth of Dionysus, as connected with the development of Phœnician commerce and the country of the cinnamon tree, is taken from Louis Dyer's "Studies of the Gods in Greece," 1891: Herodotus (iii. 111) says, "Some relate that it [κιννάμωμον] comes from the country in which Dionysus was brought up;" and (iii. 97), "The Æthiopians boardering upon Egypt, . . . and who dwelt about the sacred city of Nysa, have festivals in honor of Dionysus;" and again (ii. 46) he says, "But Dionysus was no sooner born than he was sewn up in the thigh of Zeus, and carried off to Nysa, above Egypt, in Æthiopia." Now there are several Nysas. Herodotus meant Nysa in Æthiopia, that is the Troyloditic country beyond the Soudan; for the Soumali country is the cinnamon country. On the other hand, the story of Dionysus, "the Assyrian stranger," is, *inter alia*, a myth of the development of Phœnician commerce, of which wine was everywhere throughout the eastern Mediterranean (Levant) the staple; and the Greek myths, associating the wine god with Mount Meroe, in Æthiopia, probably arose from the fact that, in the original Phœnician myth, he was not a "child of the womb," but "of the thigh" (μηρός). That is to say, these myths probably arose at the time when kinship among men had ceased to be traced through their mothers, and had already begun to be traced through their fathers. Similarly, the association of the wine god with "Nysa above Egypt" was presumably due to there having been a Nysa near Meroe, and to his Greek name being Διόννσος, this Greek form of his name being probably a folk corruption of his Phœnician name, which would almost certainly end in nisi "man." Of course, the cult of the vine and the manufacture of wine did not arise in Æthiopia, but on the slopes of the Indo-Caucasus; and hence Mount Meroe [Meru] and the Indo-Caucasian Nysa have been identified as the seats of the education of the young Διόννσος.

— Edward Burgess, known the world over as a designer of fast yachts, died at his home in Boston, July 12. Mr. Burgess had been ill since May, the first trouble being typhoid-fever, but it was hoped that he was on the fair road to recovery, when an unexpected ill turn resulted in his death. To the scientific world Mr. Burgess was known as a prominent entomologist. For many years he was secretary of the Boston Society of Natural History. He was much liked by all who knew him, and his record as a yacht designer has been most honorable.

— M. Maspero has an interesting article on the dog in ancient Egypt in a recent number of *La Nature*, a brief synopsis of which we find in *Nature*. It is illustrated by representations of dogs reproduced from Egyptian monuments, and by a mummy of a dog recently opened and sketched by M. Beckmann. In ancient Egypt, as in modern Europe, the dog was regarded both as a friend and as a useful servant. He also received the honors of a god, and there are cemeteries of dogs (corresponding to the cemeteries of cats) where mummies have been found by the thousand. Attempts have been made to identify the various species of dogs represented in wall paintings, but those naturalists who have investigated the subject have not always arrived at the same conclusions. M. Maspero points out that mummies supply more trustworthy materials for study, and urges that men of science should lose no time in examining some of them, as cemeteries of animals are being very rapidly "exploited"

— A recent number of *Nature* informs us that there has been lately formed in Berlin a "Union of friends of Astronomy and Cosmical Physics," with the view of organizing practical co-operation in these subjects of research in Germany, Austria, Hungary, Switzerland, and neighboring countries, and also in the colonies, and where membership may be desired. The object is to be sought by means of free communications of the members or groups of members to headquarters, whence advice and results of observations, etc., will be issued. Sections are formed for observations (1) of the sun; (2) of the moon; (3) of the intensity and color of starlight and of the Milky Way; (4) of the zodiacal light and meteors; (5) of polar light, terrestrial magnetism, earth currents, and atmospheric electricity; and (6) of clouds, halos, and thunderstorms. Professor Lehman-Filhés has been elected president of the Union, and the presidents of the sections are Messrs. Förster, M. W. Meyer, Plassmann, Jesse, Weinstein, and Reimann.

— The work done by university extension students at Cambridge last year was so satisfactory, according to *Nature*, that the syndicate for local lectures are encouraged to repeat the experiment this year. They will be prepared to receive a larger number of students, say from sixty to eighty, most of whom will be lodged either at Selwyn College or at Newnham College. The period of study will last from July 28 to Aug. 22, or nearly a month in all. The syndicate have just issued a detailed programme of the various courses of study; and due attention has been paid to the claims of science as well as to those of literature and art. At the chemical laboratory, on alternate days, there will be a course of demonstrations illustrating the methods of chemical manipulation in a short series of typical experiments. The pupils will be first shown each experiment, and will then be expected to repeat it for themselves. At the Cavendish laboratory, on alternate days, a course of short experimental lectures, chiefly on electricity and magnetism, will be delivered; and most of the experiments shown in the lectures will afterwards be performed by the students for themselves. Geology will be studied, on alternate days, at the Woodwardian museum, where there will be a course of demonstrations on the leading fossil types of the animal kingdom, from the specimens in the museum. A course of demonstrations, followed by practical work, will be given, on alternate days, in the physiological laboratory; and Mr. Graham, chief assistant at the

observatory, will receive students and explain the uses of astronomical instruments. Arrangements will also be made for taking small parties of students to the observatory at night. Single lectures will be delivered by various eminent Cambridge men, and in this part of the work science will be represented by Professor G. H. Darwin, who will lecture on the history of the moon or some allied subject. It may be noted that the students in science will be allowed to read in the Philosophical Library.

— William Weber, the illustrious physicist, died at Göttingen on June 23.

— The biological laboratory of the Brooklyn Institute, located at Cold Spring harbor, Long Island, opened for its second season of instruction on July 1, with a full complement of teachers and scholars. Of these latter the greater number are professors and advanced scholars in the various colleges and schools of Brooklyn, New York, and vicinity. The success of the biological laboratory has been due in great measure to the efforts of Professor Franklin W. Hooper, the curator of the Brooklyn Institute, who has been heartily aided by Fish Commissioner Eugene G. Blackford and Mr. John D Jones, as well as a large number of interested Brooklynites and residents at Cold Spring.

— At the last meeting of the Board of Trustees of the University of Pennsylvania Dr. George A. Piersol was chosen professor of anatomy, succeeding the late Professor Leidy; Dr. Harrison Allen, professor of comparative anatomy, to succeed to Dr. Leidy's chair in the biological school, and Dr. John B. Deaver, assistant professor of applied anatomy. Dr. Edward Martin was elected to the chair of special surgery. In the veterinary department Dr. S. S. J. Harger was elected professor of veterinary anatomy, and Dr. Leonard Pearson, who is now pursuing special studies at the Royal Veterinary School of Berlin, assistant professor of veterinary medicine.

— Last spring, Professor Forbes of Champaign, Ill., State entomologist, received from the Smithsonian Institution a few of the larvæ of a parasite supposed to be destructive to the Hessian fly, and said to be found only in Europe. He undertook to experiment to prove whether these larvæ are destructive to the fly here, and if so, in what degree. In order to determine this, a small patch of wheat was inclosed in a box arranged so that the grain could have light and air. A number of Hessian flies and the larvæ mentioned were put in, and the box so closed that they could not escape or other insects get in, and thus the experiment was begun. According to recent reports the larvæ have hatched and are flourishing. They are almost microscopical and seem to have been created solely to prey upon the Hessian fly. The parasite is a neatly-formed, wasp-shaped little mite, supplied with a sharp sting or auger. With unerring instinct it finds the place where the fly has laid its eggs under the husk of the straw, and, boring down into it, the parasite lays its egg inside the egg of the fly. There it develops into a grub, consuming the egg of the fly and destroying it. This is an outline of what has been proved by the experiment made. The parasite was first discovered making its depredations upon the Hessian fly in the wheat-fields of southern Russia.

— The following circular to colleges, dated June 6, 1891, has been issued by the secretary of the Illinois State Board of Health, Dr. John H. Rauch: "There is a demand from medical teachers, and young men that intend to study medicine, for a literary course preparatory to the study of medicine. This demand has been met by a few of the literary institutions in the United States, and it is hoped and believed that it will be much more generally met during the next two years. The following institutions now offer science courses for students that intend to study medicine, or that intend to teach or otherwise engage in biological work: (1) University of Wisconsin, (2) University of Pennsylvania, (3) Johns Hopkins University, (4) University of Notre Dame, (5) Yale University, (6) Cornell University, (7) Princeton University, (8) Lake Forest University, (9) Northwestern University, (10) West Virginia University, (11) University of Kansas. As must be obvious, such a course should be based on biology, and should include thorough work in this science, as well as in osteology, comparative anatomy, and chemistry, with English, French, German, some Latin, clay modelling, free-hand drawing, mineralogy, mathematics through trigonometry, physics, mechanics, logic, general and pharmaceutical botany, and (in the last year) psychology. It is of course understood that botany, being a branch of biology, should have a prominent place in the course. The catalogues of the universities mentioned contain the lists of studies offered in their science courses. Such a course should extend over four years. This will involve no loss or waste of time to the student. The Illinois State Board of Health now requires that students of medicine matriculating in the autumn of 1891, or thereafter, must study medicine four years, and must attend three courses of lectures, no two in the same twelvemonth, in order to obtain a license to practise in Illinois. This rule will apply also in some other States. The Illinois State Board will, however, recognize a thorough course in science, such as indicated above, as equivalent to two years' study and one course of lectures, thus enabling the student to enter the second class in the medical college. This makes the full time of study six years in the literary and medical schools, or two years less than is required of the student pursuing a strictly classical course. Not only will time be thus saved, but the science student will be much better prepared to enter the second course of the medical school than will the classical student to enter the first year. The Illinois State Board wishes to make up a science course that can be recommended to any college wishing to adopt such a course, and having but little time to study the subject, I desire to enlist your aid and have your advice in the matter so as to make the course as practical and as beneficial as possible. Will your faculty, therefore, make out such a course as it thinks best for the purpose, and send it to the secretary of the board? The demand from medical teachers and from students of medicine having been met by some universities, must be met by all that would continue to hold a high rank as educators of young men for the work of life."

— In a note communicated to the French Academy of Sciences, says the *International Journal of Microscopy*, M. A. Lothelier states that in *Berberis vulgaris*, *Robinia pseudacacia*, *Ulex Europæus*, and other plants, the formation of spines is dependent on the access of light. Plants grown in comparatively little light present very few spines, but those grown with free access to it have more numerous, more differentiated, and more developed spines. M. Lothelier has observed that the loss of assimilation power caused by the development of spines is usually balanced by the stronger growth of the axillary leaves.

— The skin of toads and salamanders has lately been submitted to microscopical examination by Mr. Schulz (*Intern. Journ. Micros.*), who finds that there are two kinds of glands present in the skin of these animals, viz., mucous, and poisonous. The former are present all over the body; the latter are confined to the back of the body and limbs and the ear region behind the eyes; and in the salamander are present at the angle of the jaw. The poison-glands are larger than the mucous glands in the salamander, are oval, and have a dark granular appearance, due to strongly refractive drops of poison, a good reagent for which is copper hæmatoxylin. The poison is secreted by epithelial cells lining the glands, and, when the animal is stimulated by electricity, it is exuded slowly in drops by the toad, but discharged in a fine jet, sometimes to the distance of a foot or more, by the salamander. The anæsthetic action of the poison of the toad and the use to which it is put in medicine by the Chinese have frequently been pointed out.

— K Hartmann, in *Gesundheits Ingenieur*, relates a case in which a lead pipe was cut through by an insect that was actually found with its head in the hole pierced by it. A workman was called in to repair a defective pipe which had been injured on a previous occasion, as was reported, by a "nail hole" occurring in a soldered joint. This time the worm (a wood wasp) causing the mischief was found *in situ*. The hole on the exterior of the pipe was of a rounded form, about one-quarter of an inch long by one-eighth inch wide, and the penetration was through the entire thickness of the metal. Though of rare occurrence, says the *Scientific American*, well-authenticated instances of similar injuries by insects are on record.

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PHYSICAL DEVELOPMENT.[1]

GREAT interest has, I am happy to state, been taken in the results already obtained by the Polytechnic Physical Development Society. Their publication at the Leeds meeting of the British Association has caused inquries for further information to be addressed to us from all parts of the kingdom, the continent, India, Africa, and America. I mention this because it shows that the public are beginning to realize that the physique is something more than a matter of great interest to scientific observers; that it is, in fact, a subject of practical importance to each one of us; and that the time is ripe for the formation of an organization to deal with it as a science and an art.

It is, doubtless, pretty generally known that, broadly speaking, the difference in the physique of man in the highest centres of civilization and that of man in a savage — or, to be more accurate, in a lower state of civilization — is, with the exception of parts of the brain, greatly in the favor of the latter; that is to say, we have obtained the advantages of civilization, with the above exception, at the expense of the body; and inasmuch as we are continuously making further advances in knowledge, and applying that knowledge in the ordinary routine of daily life, the tendency of this progress still is to the further detriment of the body. This is not an agreeable fact to contemplate, and the reminder that the "fittest" will survive neither affords us compensation for the injury nor points out the means by which it may be obviated; for the class of the fittest for the circumstances of a generation ago is not the class of the fittest for the circumstances of to day, and the class of the fittest for the circumstances of to-day will not be the class of the fittest for the circumstances of the next generation. Hence this most important question arises, How can we obtain for civilized man a physique equal at least to that of man in a lower state of civilization, and make the further advances of knowledge tend to the advantage of the body? The answer to this question, I shall show, lies in the ascertainment of the effects of the conditions of our habits and surroundings upon the body, and the application of that knowledge to our own protection and advantage.

Nearly twenty years ago I commenced the investigation of this subject, and the results of that research I laid before the British Association in 1886–87. Then I showed that the size and shape of the chest varied as I varied the conditions to which it was subjected. For example, when I submitted a chest to conditions that tended to develop it, that chest increased in size, and its form or type changed accordingly. When I submitted a chest to conditions that tended to decrease it, that chest decreased in size, and changed its form or type accordingly. I ascertained that those results were absolutely invariable, and could be carried out within such wide limits that, on the one extreme, they embraced the class of the non-survivors, through consumption, and on the other, the finest physique of the class of the survivors or fittest. I pointed out the fact that we had an example of one type of chest forming a series of types that have varied precisely as the conditions to which it was subjected have varied. At birth the male child of all classes has the same type of chest, but at maturity he has that of the class to which he belongs. We have the same relationship between conditions and type; on the one hand, in those who use wind instruments, or who by their occupations require to greatly use their lungs; and on the other, in those who spend a great portion of their time in a stooping position, or who compress their chests either by the instrument they use in their work or by a corset. The great development of the muscles of the trained athlete and the wasted muscles of the paralytic are due to to the conditions of their use and disuse respectively. We know that the head has been altered in shape by direct pressure, and that the greater size and the more complicated arrangement of the brain of a European to that of an aborigine of Australia is produced by the greater mental training of the former. The difference between the hands and fingers of a pianist and those of a man accustomed to lift heavy weights is produced by the conditions of their occupations. Upon the presence and absence respectively of shoes depends the difference in the size and shape of the foot of a Chinese lady and that of a woman in the uncivilized state. The color and thickness of the skin vary according to the conditions to which it is subjected, and there is the same relationship between the size and shape of each part of the body and the conditions to which it is subjected. Therefore, the type of man after birth is solely produced by the conditions to which he is subjected. Hence the formation of race by man's continuance under the same conditions, and its subsequent division into sub-races and families by his migrations into new conditions and the minor differences therein. Hence also the difference between the same species of animals under the conditions of nature and of domestication, between the products of the same seeds when sown in different localities, between the same plants when placed under different conditions, and the return of man, animal, or plant to former types when subjected to the conditions that produce that type.

It would be difficult to overestimate the immense importance of the facts just briefly referred to. They prove to us beyond the possibility of a doubt that man is what his habits and surroundings make him; that he is a member of the class of the survivors or fittest because the conditions, as a whole, of his habits and surroundings are favorable to him;

[1] Godfrey W. Hambleton, president of the Polytechnic Physical Developmt Society, London, in Physique.

that he is a member of the class of the non-survivors, those who prematurely disappear, because the conditions as a whole of his habits and surroundings are unfavorable to him; and that he can so order his habits and surroundings that they shall tend to his advantage. A great work and a great future lie straight before us. We have to ascertain the tendencies of all the conditions to which our bodies are subjected by our habits and environment, in order to apply that knowledge to our own protection and advantage. And that is the sphere of true physical development.

An important step towards the attainment of this great object has been taken by the formation of a society to apply the principles of physical development in the ordinary routine of daily life. Some twenty-five members joined at the first meeting of the Polytechnic Physical Development Society. Now, thanks to the courteous and cordial co-operation of Mr. J. E. K. Studd and the authorities, upwards of three hundred members have entered their names on the books; and when the society is better known and the great benefits it does confer are recognized, I do not doubt that that number will be considerably increased. At Leeds I gave the results obtained by a hundred members. The average increase of their chest girth was $1\frac{3}{4}$ inches. I divided them into three classes, the average increase of the chest girth of the third class being $1\frac{1}{4}$ inches, that of the second class being $2\frac{1}{8}$ inches, and the first class $3\frac{3}{8}$ inches. There has been a considerable increase in the range of movement of the chest, the average then being, I think, $4\frac{1}{2}$ inches. Hutchinson's standard of vital capacity has been greatly exceeded, and in the power of inspiration and expiration the majority belonged to or exceeded his "remarkable" and "very extraordinary" classes.

At the subsequent examination for the society's gold medals, the first medallist had obtained an increase of the chest girth of $6\frac{1}{2}$ inches, the second an increase of 5 inches, and the third $4\frac{3}{8}$ inches. The society's medals for the best physique were awarded to members who had exceeded Brent's "medium" standard by 3.67 inches, 2.42 inches, and 3.32 inches, and twenty certificates were given to those who had obtained and exceeded that standard.

I am glad to say that increase continues. We have just held our second general annual meeting, and I find the average increase of the chest girth of one hundred members is now two inches, that of the third class being $1\frac{3}{8}$ inches, the second $2\frac{1}{4}$, and the first $3\frac{5}{8}$. That increase has taken place in small as well as in large chests, whether the men were tall or short, under or over twenty-one years of age, and with or without previous gymnastic training. Our members are engaged from eight to twelve or fourteen hours daily in over fifty different trades and occupations, amongst them being clerks, compositors, printers, watchmakers, carpenters, engineers, drapers, warehousemen, etc. The variations in the chest girth and vital capacity that have taken place are most instructive. I have frequently noted a large decrease when the members were training too much in the gymnasium, or engaged in extra work, stock taking, cycling, and when they neglected to follow the directions given them. In fact, the increase or decrease observed has been in direct relationship with a corresponding change in the conditions of their habits or surroundings. It is satisfactory to note that the number of chest girths of from 38 to 40 inches and upwards is steadily increasing. We have also many members who have nearly attained Brent's "medium" standard, which is 5.40 inches above the average of the artisan class, and 3.17 inches above that of the most favored class. The importance of these facts will be seen when it is borne in mind that this is a new society, carrying new principles into practice, that its members are placed under more or less unfavorable conditions, that it is purely voluntary, and that its members leave us when they leave the institution.

Perhaps the best way to explain the practical work of the society is to describe what happens to a new member on joining it. He is placed in an erect position, his shoulders are brought well back, and his clothing so loosened over the whole of the chest that it permits full and free movement. I find in nearly every case the clothing is from one to two inches or more too tight. Then he is shown the simple movements that are necessary to throw the weight of the shoulders on the spine, he is taught to inhale and exhale deeply through the nose, and to use the spirometer and manometer. We explain to him that the conditions of his habits and surroundings tend either to his injury or to his advantage. He is told to avoid those that tend to act injuriously, and where that is not possible or practicable, to ascertain their amount and to counteract their effects, and to place himself under those that tend to his advantage. We request his careful attention to these conditions, and deal first with those that have to be avoided. The habit of stooping, positions that cramp or impede the full and free movement of the chest, or a faulty carriage of the body, are very injurious. Habits that tend to the disuse of the muscles or to their excessive use are to be avoided. Breathing through the mouth, or breathing air that has a temperature much above that of the external air, or that is impure, or that contains dust, is very injurious. Wearing tight-fitting or too heavy clothes, braces, corsets, or shoes with high heels and narrow toes, tends to impede the full and free movement of the body and is injurious. And whatever of his habits or surroundings tends to act injuriously or to produce such acts must be avoided.

We tell him to acquire the habit of holding the body erect, the shoulders back, and the chest well forward; to breathe through the nose, and to take deep inspirations followed by full expirations several times daily; to develop the muscles, especially of the chest, by gymnastic exercise on Ling's system; to go in for the daily tub or swimming; and to have the clothes made quite loose at full inspiration, and to see that they do not impede either by their weight or shape the free movement of the body. We advise him to live in rooms that are in free and direct communication with the external air night and day, summer and winter, and to take care that their temperature is not too high; to spend as much time as possible daily in the open air, and to maintain the temperature by muscular exercise. We point out to him that walking is a most healthy exercise, and that broad toes and low heels tend to promote it. We tell him to practise singing, and to take advantage of some form or other of athletics whenever the opportunity presents itself. And whatever of his habits or surroundings tends to his advantage or to produce acts having that tendency must be adopted.

We are all of us at times subjected to unfavorable conditions that we cannot, under present circumstances, avoid. For example, it would be difficult to be present at any public meeting in a large building without having to inhale both impure and overheated air. But when we have obtained a certain amount of physical development, a few deep inspirations followed by full expirations in the open air will be sufficient to counteract that. Again, the occupation or business in which we may be engaged may necessitate a somewhat cramped position of the chest, but on leaving, a trained

man will soon obtain compensation for that by holding the body erect and taking proper breathing exercise. The main point is to ascertain our unavoidable injurious conditions, and to arrange the other conditions so that the tendency of the whole is decidedly in our favor, and it will take a well-developed man — and by that I mean a man having a physique between Brent's "medium" and "maximum" standards — but little time and trouble to accomplish that. These directions are very simple, easy to carry out, and in one form or other are within the power of each one of us. But they effect a complete change in the conditions to which the body is subjected, and to make that change with safety it must be slowly, gradually, and uninterruptedly effected.

I will now point out some cases in which physical development is urgently required, and where its adoption will render an immense public service. Take the case presented by the army. Considerable attention has recently been directed to the large amount of inferior physique that is present in the ranks. On the 1st of January, 1889, the army numbered 202,761 men, but of these there were 82,979 whose chest girth was under 36 inches, — that is, from 31 inches up to 36 inches, — and only 16,324 who had a chest girth of 39 inches and upwards. Now on Brent's "medium" standard there ought to have been none under 36 inches, and 67,236 ought to have had a girth of 36 inches and upwards. There is, however, another mode of showing the presence of this inferior physique, and that is by the great liability of the army to disease under ordinary circumstances. During the year 1888 there were 193,233 admitted into hospital, 1,845 died, 2,078 were sent home as invalids, 2,776 were discharged as invalids, and 10,715.97 were constantly non-effective from sickness. It is obvious that had the men been of good physique, and subjected to fairly good conditions, there would not have been anything like this serious amount of sickness, invaliding, and death. Why should not these men be placed in a position to successfully compete with the unfavorable conditions of their surroundings by the introduction of physical development?

A reference to the tables in the supplement to the Registrar-General's report, showing the comparative mortality of those engaged in different trades and occupations, will show the necessity for the diffusion of the knowledge of physical development amongst those engaged therein. Life assurance and sick benefit societies would not only considerably add to their incomes and increase their stability by the recognition of this relationship between conditions and type, but they would also by that very act become powerful agents in the promotion of national physique and public health.

The introduction of physical development as a necessary part of the education of children is urgently and imperatively demanded. They have a splendid type of chest at birth, the proportion of chest girth to height being a little above Brent's "maximum" standard, but under the present system of bringing up children, they are, from the moment of birth, right through the whole course of modern education, submitted to unfavorable conditions, so that for a height of 51.84 inches there is a chest girth of 26.10 inches, instead of one of 35.18 inches, or a loss in about ten years of nearly nine inches. Here you have the best standard of chest girth. Is it too much to ask that the conditions of the child's surroundings, as a whole, shall be so arranged that it may be retained? Look at the poor, puny chests we meet with everywhere, and at the reports of the Registrar General, and then we shall see the grave responsibility that lies upon us for producing such a change and permitting it to continue.

The cases just noted evidently require the introduction of physical development, but where shall we find a man, a woman, or a child in civilized countries upon whom its adoption would not confer a great benefit? We are here face to face with a work so great that it will require all the intelligence, the energy, the influence, and the means of a well-organized body to accomplish it. The workers are here, an important section of the public is ready to co-operate, and the time for action has come. Why should we not have a national association to meet this great national want?

CONTAMINATED WATER SUPPLY FOR LIVE STOCK.[1]

There is no fact better known to the sanitarian than that one of the chief sources of danger to life and health is the contamination of drinking water. If a malignant form of fever makes its appearance in a family, which cannot be explained by the history of actual exposure to contagion, the water supply always comes in for an early and liberal share of attention. The instances are sufficiently numerous in which the investigator is enabled to trace the malady to this source, to warrant every reasonable precaution in procuring a pure water supply. Nor are these facts known to the sanitarian alone. The reading public have been sufficiently enlightened on this subject to enable them to avoid much of the danger from this source.

While we are beginning to take a fairly lively interest in our personal dangers and the methods calculated to avert them, we have yet hardly taken time to consider the economic question of how far our live-stock industry may be affected by the same class of causes. We drill down into the solid rock to procure a water supply of unquestioned purity for family use. We boil, or subject to other purifying means, all suspected samples before they can be used. This is well. But all this time our helpless dumb creatures may be compelled to drink from a shallow slough, foul with decomposing vegetation, or from a surface pond almost at boiling temperature under a summer sun, where the minute forms of animal and vegetable life generate in such profusion as to render the whole a mass of animate slime.

No one who has had a glimpse of the microscopic world would expect a human being to take a draught of such a beverage and live. But our animals are not only expected to live, but to thrive under such conditions. That these expectations are frequently disappointing, I will cite an instance or two in proof. During the latter part of the summer of 1890, I had occasion to investigate a severe outbreak of disease on a farm in one of the counties of Iowa. The animals, including horses, cattle, and pigs, were all affected in the same way. The local symptoms were largely confined to the throat. There was a swelling, partial paralysis of the walls of the air passages, and painful and difficult breathing. The animals attacked uniformly died after an illness of about two days. The disease I could not recognize as belonging to any of the well-defined types with which I was acquainted. Here were horses, cattle, and pigs sick and dying with disease showing the same symptoms in all.

There are few if any of the specific forms of disease that spread, as epizootic, among the widely differing species of domestic animals. I could not classify the disease, and at once set about the task of discovering, if possible, some common source of exposure. The pastures, buildings, and water supply were each in turn subjected to careful scrutiny.

[1] M. Stalker, in the May Bulletin of the Iowa agricultural experiment station.

The buildings were such as are to be found on ordinary Iowa farms, fairly comfortable and clean. I could find no clue in the quantity or quality of feed that promised to lead to a solution of the difficulty.

On investigation of the water supply, I found that most of the animals on the farm drank from a small creek that ran a zigzag course through the premises. The stream was in part supplied from a series of springs, and in ordinary seasons afforded a fair amount of water, which ran, at least for a portion of its course, over a gravelly bed. The dry summer of 1890, with several previous ones showing an abnormally light rain fall, had so reduced the amount of water that it had ceased to run. On making examination and conducting inquiries, I ascertained that it had been the custom on the farm to throw the carcasses of animals down the steep bluffs into the bed of the stream. I further learned that during the summer, chicken cholera had prevailed on the farm, and that a large number of chickens had died and been thrown over the bank. I was also informed that the hog-cholera had caused the death of a considerable number of swine, the carcasses having been treated in a similar manner. The several yards occupied by horses, cattle, pigs, and barn-yard fowls were on the hillside, with abrupt drainage into the creek. In addition to this, large heaps of fermenting manure were deposited about the foot of the hill, near the edge of the stream where the animals went to drink.

A few of the animals on the farm had not had access to the stream, but had been watered from a well. None of these had showed signs of sickness, though they had been in daily contact with those that had their water from the pools in the bed of the stream, and even with some of the sick. On looking up the local geography of the neighborhood, I found that a number of farmers had built their homes along the banks of this stream, and had been accustomed to make use of it in much the same way as the farmer above referred to. Inquiry elicited the fact that on no less than four farms situated on the banks of this stream, animals had died showing symptoms identical with those on the farm first investigated. I regarded the evidence as sufficient to make out a strong case against the impurity of the water, and gave an opinion accordingly.

The above is but a single instance out of many that have come under my observation. It is one of the most glaring, but by no means one attended with the greatest degree of loss On another occasion where a high rate of mortality had prevailed among the cattle running on the open prairie, I was able to trace the cause to contamination of surface water. An animal, dead from anthrax, had been drawn into a basin on the open prairie. Later the rains filled the basin with water, and about one thousand cattle on the range had access to the pond for water supply. The result was that about ten per cent of all the animals having access to the impure water died from anthrax. The teachings of these object lessons are sufficiently obvious. These animals are endowed with organizations not unlike our own, and the manifest laws of being and of health can no more be violated with impunity by them than by ourselves.

THE LAST ENGLISH HOME OF THE BEARDED TIT.[1]

IN the memoir of the Geological Survey of the country round Cromer [England], is a rough sketch-map of the outline of the north-west corner of Europe as in all probability it existed at the newer pliocene period, in the far-off days when the primitive vegetation and monstrous creatures of a still earlier world were slowly giving place to plants and animals of "more of the recent" types.

A great river, since dwindled to the insignificant Rhine, with its mushroom castles and ruins, swept through fir woods and swamps to an estuary hemmed in to the westward by a coast-line unbroken, excepting here and there by a tributary stream, to John o' Groat's, rolling down in its sluggish current stumps of trees, and bones of elephants and bears and beavers, to be washed long ages afterwards from the "forest-beds" of Sheringham and Runton. The swamps through which the old estuary once cut its way lie buried now in places a hundred feet or more deep, beneath Norfolk turnip fields and pheasant coverts.

The fens of the Great Level, which, before Dutch drainers and dyke-builders had reclaimed the second Holland, were perhaps their nearest counterpart in the England of human times, are scarcely less things of the past. The marsh devils, which, until St. Bartholomew interfered and drove them off with a cat-o'-nine-tails, held open court there, and, as Matthew of Paris tells in his "Greater Chronicle," came out in troops to maltreat the few hardy Christian settlers, who, like St. Guthlac, as penance for past wild lives, sought holy retirement there — dragging them, bound, from their cells, and ducking them mercilessly in the black mud, "*cœnosis in laticibus atræ paludis*" — now cower invisible in the ditches, or sneak out as agues, to be ignominiously exorcised with quinine. Hares and partridges have taken the place of spoonbills and bitterns, and ruffs and reves; and, where a few years ago wild geese swam, ponderous Shire cart-colts gallop, scarcely leaving in summer a hoof-mark on the solid ground.

The old order almost everywhere has changed and given place to new. But there is a corner left — the district of the Broads of Norfolk — where one may still see with natural eyes what the world in those parts must have looked like in days before the chalk dam which connected England once with the mainland was — happily for Englishmen of these days — broken through, snapped by a sudden earthquake, or slowly mined by countless generations of boring shellfish, until it gave way under the weight of the accumulating waters of the estuary, choked to the north by advancing ice, or tilted westward by some submarine upheaval. There, with a very small stretch of imagination, one may still hear mastodons crashing through the reed-beds, and British hippopotamuses splashing and blowing in the pools; and, as every now and then an incautious footstep breaks through the raft-like upper crust of soil, and imprisoned gases bubble up, one may, without any stretch of imagination, smell the foul stenches of pliocene days.

The climate in those days, geologists tell us, judging by the fossil plants of the time, must — before the country was wrapped in ice — have been much what it is in Norfolk now. "If the various sections of the upper fresh-water beds are examined, we find," writes Mr. Clement Reid, who surveyed the country round Cromer, where the forest-beds are most exposed, "that all appear to have been formed in large shallow lakes like the present broads, or in sluggish streams connected with them."

Three considerable rivers, the Bure, the Waveney, and the Yare, after meandering through level meadows and marshes, — none of the three, according to Sir John Hawkshaw's estimate, with a fall of more than two inches in the mile, — join and meet the full strength of the tide in Breydon Water. The outflow is checked, and the volume of the streams, finding no other way to dispose of itself, has spread out into side-waters and back-waters, wherever the law of levels, the only law to which it owns allegiance, has admitted the right of way.

The result is a triangle of some fifteen or twenty thousand acres or more in which — as in the abyss through which Satan winged his way in search of the newly created world,

> "Where hot, cold, moist, and dry, four champions fierce,
> Strove for the mast'ry"—

land and water hold divided empire. In places the water seems at the first glance to be carrying all before it. Broad sheets (some of them a hundred acres or more) spread almost unbroken surfaces over unfathomable depths of mud. But the encircling rings of rushes, dwarf alders, and other multitudinous marsh plants,

[1] T. Digby Pigott, in the Contemporary Review for July.

creep in insidiously, each generation growing rank and dying to make soil on which the next may find a footing for another step inwards.

The water revenges the encroachment by flooding the land wherever it finds a chance, and undermining when it cannot overflow, till it is impossible to say where the one begins and the other ends. One walks almost dry-shod across what had seemed a dangerous pool, and the next moment sinks over one's fishing stockings in what anywhere else would have been dry land. The confusion of ideas as to the relative solidity of earth and water which results from an hour or two spent in exploring a soft "broad" marsh is not lessened as one sees the huge brown sail of a "wherry"—the craft which is said to go closer to the wind than any other afloat — moving straight up to one, to pass by at eight or nine miles an hour, sailing to all appearances on dry ground. The navigable channels are most of them natural cuttings in the dead level of the marsh, invisible at a very few yards' distance.

The name of the long pole, which is one of the most important parts of the equipment of the Norfolk wherry, the "quant," is, by the bye, a memorial of the days of Roman occupation. It was with a quant, spelt a little differently in Virgil's day, that Sergestus, in the immortal boat race, tried to shove off his galley when he had cut his corner too finely and run aground; and with a quant that Charon ferried his passengers across the Styx: —

"Ipse ratem conto subigit velisque ministrat."

The entire district is unlike anything else in England, and, apart from its power of recalling the past, has an exceptional interest of its own for naturalists. It is the paradise of shy creatures of all sorts, birds especially, which love mud, or water, or reeds; and has been the last settled English home of more than one rare species. Their number, in spite of the keener interest taken of late years by land-owners in bird preservation, steadily decreases.

The avocet, with its spindle shanks, and beak turned up like a shoemaker's awl, which not very long ago bred so freely in the salt marshes that "poor people made puddings and pancakes" with their eggs, is now the rarest accidental visitor. The bittern, comparatively lately a regular breeder there, no longer "guards his nest" among the sedges and reeds; and ruffs and reeves are as rare as they once were common. But there is — or at least till last year was — one little bird, which, driven from every other part of England, has made the broads his own peculiar property, and himself thoroughly at home there. Hardy and modest in his wants, the bearded tit has been essentially a home-staying bird. His ancestors seem to have elected, generations ago, that, whatever the advantages of a winter in Algeria, the disadvantages were greater, and that, on the whole, it was better to face the evils that they knew than fly to others that they knew not of.

The "developments" of the family ever since the decision was made have been in a direction to fit them for a quiet life among the reed-beds. Other birds, smaller even than they, whose forefathers were of a different opinion, have wings now so perfected that, when soft animal food fails in England, they think nothing of a flight of a few hundred miles to a sunnier spot where fat insects may still be found.

The bearded tit, with his little round wings and the heavy canvas of his long tail, cannot do what they can. But he can do what they cannot, and make the most of what is to be got in the way of food at home. In the swampy grounds from which his reed beds grow are quantities of very small snails. Some early ancestor, feeling the pinch of hunger, ventured experimentally to pick one up and eat it, and finding out the sustaining qualities of the rich inside meat, brought up his young ones to eat them too, and make light of the aches which a sharp-edged, hard shell swallowed whole must have caused in a delicately-coated stomach.

They, in their turn, brought up their young on the same Spartan system, and now — unlike other tits, which have most, if not all, of them tender insides, suitable enough for digesting soft insects, but unfit to do justice to anything harder than a seed well steeped in gastric juice — the bearded tit finds himself the possessor of an honest, study gizzard, which can grind up, without the least inconvenience to the owner, any number of the shells of the snails which are its chief delicacy. As many as twenty little snail-shells have been taken from the crop of one bearded tit.

We wonder now why good people should have been so much alarmed as once they were at the doctrines of "development." It is the teaching of the Parable of the Talents extended from the spiritual to the physical world, — powers neglected or abused withdrawn, others well used increased.

The shape and color of the bearded tit are as specially adapted as is its stomach to the peculiarities of its surroundings. Visitors to the broads in midsummer who may have caught glimpses of the bird, showing itself for a minute or two at a time, a conspicuous object against the green of the young rushes, may find it difficult to realize that the bearded tit is, when invisibility is of most importance to it, protected by color and form scarcely less perfectly for all practical purposes than are leaf-insects, or stick-caterpillars, or the wonderful creatures described by Professor Drummond in his "Tropical Africa." But such is the case. The eggs are laid about the middle or end of April, when the tall reeds, among which the nest is built an inch or two from the ground, are ripe for cutting.

The prevailing tints of the entire district — land, water, and sky — are then the cinnamons, straw-colors, and pale blue greys, miraculously reproduced in the feathers of the bird, which might pass for the emancipated spirit of the dead reeds of last summer. The long tail, with its pointed end, hangs down as its owner comes in sight for a moment to look about him, the counterfeit presentment of a faded frond of the stalk he grips, one foot above the other.

The hoopoes, as the legend goes, wear their crown of feathers in memory of the day when their ancestors saw King Solomon almost fainting under a sudden burst of noonday sunshine, and sheltered his royal head with a parasol of overlapping wings. It may be as a mark of approval of the manliness with which he faces winter on the broads, when snipe and other birds have been driven off by the cold, that the bearded tit now wears the long silky black moustache — his own peculiar adornment — which hangs from each side of the beak. As in the nobler species, the moustache is noticed only in the males. There is a prolongation of the cheek feathers of the female also, but not the same contrast of colors.

For all ordinary winters the bearded tit is amply provided. But, unhappily, last winter — the longest on record since the days of Lorna Doone — was not an ordinary one. Fifty-nine days of consecutive, almost sunless, frost were recorded in London, and in parts of the broads the weather was even more severe. The snails for weeks and months must have been glued fast to the ground or rush-stalks, — tantalizingly in sight for much of the time, as there was no great quantity of snow, but as much out of reach of a small beak as flies in amber. The birds when most in need of a warming meat-diet were driven to depend almost entirely on such dry ship-biscuits as the seeds of reeds, without even water, except here and there in the running streams, to wash it down, and have suffered terribly in consequence.

It was on one of the bright mornings towards the end of April last, when, in spite of a wind still nailed in the east, a warm sun, and such spring sounds as the call of the nut-hatch, — a pair of whom had from daybreak been carrying on a lively conversation over an unfinished nest in a box in the garden, — encouraged the hope that the return of the glacial epoch might not after all be so near as for the last six months had seemed probable, we found ourselves, after an early breakfast and drive of fourteen miles, landing from a boat on the edge of a marsh skirting a broad. The marsh is strictly preserved, and on it, as lately as last summer, bearded tits were plentiful. We had come in the full expectation of seeing both birds and nests, and were, if anything, rather encouraged than otherwise when the keeper — in the pessimistic tone common to men of his order when conscious that there is an unusually good head of game in front of the guns — told us that, though there was a nice lot of reeds uncut, he "doubted" we should not find any tits, as to the best of his belief there was not one of them left in the place.

But before an enjoyable day was over his words had acquired a

different meaning. We tramped the marsh, which teemed with other bird life, backwards and forwards. Twice we flushed a mallard from a nest well filled with eggs. One nest, with a clutch of ten, was downed almost as thickly as an eider duck's, with a well-trampled path like a miniature sheep walk leading from it to the water's edge. From behind a stock of reed-sheafs we watched for ten minutes a pair of teal playing together — unobserved, as they supposed — in a rushy pond close by. Shovellers, with fantastic coloring and great flat beaks out of all proportion to the size of the bird, rose more than once within a few yards of us, and after circling once or twice, pitched again not far off. Tired-looking swallows sat disconsolately in parties of five or six on bushes, or rose to skim over the water in a half-hearted way, and light again.

A pair of redshanks crossed us once or twice, flying in line, one just behind the other, whistling loudly as they flew. Cuckoos called, and overhead snipe poised themselves, drumming and bleating and dropped like stones as they neared the ground. In the nest of one of them we say a beautiful instance of "protective coloring," the marvel of which never loses its freshness. The keeper the day before our visit, had found the nest, and for our benefit had marked the spot. It was in a line between two bushes, within half a dozen yards of one which stood alone and unmistakable on flat ground, with nothing on it bigger than a few short sprits which could hide the nest. As we neared the spot, the bird, to show there could be no mistake in the mark, rose close by us. For more than a quarter of an hour we looked, — three pairs of eyes, one pair the keeper's,—crossing and recrossing every foot of the ground, and were giving up the search as hopeless, thinking that a crow perhaps had hunted the marsh in the early morning before us, when in the middle of a tussock of sprits at our feet we saw a maltese cross of very green eggs, mottled irregularly with brownish-red, exactly imitating the bed of green moss from which the sprits grew. The color of snipes' and many other eggs is very volatile, and no one who has only seen them "blown" in a cabinet can quite realize their beauty when seen in the nest, fresh laid and untouched

At intervals of our tramp on shore we took the boat, rowing across corners of the broad, or pushing our way through ditches or narrow twisting channels. We saw coots' nests in plenty, and one unfinished nest of the great crested grebe, — the one rare bird which has made some return for the trouble taken of late years for its preservation by becoming more common. A floating mass of weeds, fished up, wringing wet, from the top of the water, looks a hopeless nest for a bird to hatch her eggs in; but, like a damp hay-stack, it generates very considerable heat. "In a grebe's nest," writes Mr. Southwell in the third volume of "Stevenson's Birds of Norfolk," just published, "in which were three eggs and a newly hatched young one, the thermometer rose to 73°, showing that the nest, so far from being the cold and uncomfortable structure by some supposed, was a real hotbed. On inserting the thermometer into a beautifully neat and dry coot's nest, which the bird had just left, I found the temperature to be 61°. The day was wet and cheerless, and the maximum reading of the thermometer in the shade was 58°."

We saw through our glasses several crested grebes playing on the broad. Oddly enough, the common little grebe — the "dabchick" — is less plentiful in Norfolk than it is in St. James's Park, where last year as many as six pairs, all wild birds, nested and brought off their broods.

For six or seven pleasant hours we hunted marsh and broad with eyes and ears open. But not once did we catch sight of a feather, nor once hear the silvery "ping" of the note, of the bearded tit.

It was, of course, one corner only of a wide district, over the whole of which the bird has been well known, that we had explored. There are other broads and marshes where local circumstances may have tempered the killing wind. There, while we looked for them in vain, busy parents may have been working hard from morning till night to cater for the wants of hungry families safely hidden in daily thickening growths of bog flowers and grasses, and another year the deserted reed-beds we visited may be repeopled.

But as we drove home the conviction forced itself more and more strongly upon us, that, from one at least of its most favored haunts, the bearded tit has disappeared, and that it is not improbable that very soon — perhaps before this year is over — naturalists may be telling the sad story of the extinction of one more English bird.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Atmospheric and Seismic Influences.

IN your issue of May 1, I had the honor of reporting a coincidence in time between two peculiar phenomena, the first the collapse of the fire-area of Halemaumau in the crater of Kilauea on March 5, and the second an unprecedented fall of the mercury in Honolulu to 48° F., on March 4. I remarked that this was perhaps not a mere coincidence. I now have the satisfaction of reporting a third phenomenon occurring at the same time, which is undoubtedly connected with the second, and which may aid in finding a connection with the first.

By the return from the Caroline Islands of the missionary barkentine "Morning Star," on the 19th of June, we get word of a severe hurricane on Strong's Island, or Kusaie, on the 3d, 4th, and 5th of March (or 2d, 3d, and 4th here). This island is in about 5° north latitude, and 162° east longitude, or about 3 400 miles west of Honolulu. Most of the breadfruit and cocoanut trees were uprooted, and a majority of the houses destroyed. The force of the waves threw up an islet, half a mile long and five feet high, on the outer edge of the fringing reef. The severity of the blow was from the north east. No barometer was observed there. No gale was experienced at other islands, so far as heard from. There was a sudden fall of the barometer at Honolulu on the 2d of March (3d at Kusaie).

The atmospheric change here is readily connected with the disturbance at Kusaie. To show a connection of the latter with a disturbance of the earth's crust on Hawaii is not quite so easy, although I believe that coincidences between hurricanes and earthquakes are common. What happened on Hawaii was a subterranean fracture in the lava duct of Kilauea, which let its contents escape and apparently become distributed under the Kau desert to the south-west, where lively earthquakes occurred. I suggest that a common cause of the atmospheric and the seizmic disturbances is to be sought for in astronomical conjunctions, possibly connected with sun-spots. Account should probably be taken of the severe blizzard of March 10, in England. SERENO E. BISHOP.

Honolulu, June 30.

The Collections of the Late Professor Parker, F.R.S.

IN a letter recently received by the undersigned from Professor W. Newton Parker, F.Z S., of the University College of Cardiff, Wales, a son of the late eminent Wm. Kitchen Parker, the vertebrate morphologist, I am informed by its writer that "My father's executors have decided to sell the greater part of his collection, which includes numerous skeletons (mainly of birds) and a large number of slides of *Foraminifera*, etc. Do you think that any of the public institutions in America would be likely to want any of these? . . . I hope you will forgive my troubling you about this matter, and I only venture to do so knowing you to have been a friend of my father's, who has an interest in him and his work."

The late Professor Parker's labors in comparative morphology for almost the last half century are so very widely known to science the world over that it is quite unnecessary for me to dwell upon them in the present connection. Their results, as published in the proceedings and transactions of the various learned societies of Europe since 1857, have long become in the highest degree classical, and they are as standard as they are imperishable.

Pressed by the necessity to obtain the requisite animal forms wherewith to illustrate his many and voluminous works, Professor Parker became a patient and indefatigable collector of morphological material, and at the time of his death his private cabinets stood among the largest and best in existence. As will be seen from what his distinguished son says, that collection is soon to be placed upon the open market for disposal. From my own personal knowledge, gained through a correspondence with its collector extending over a number of years, I can state that it simply represents a perfect mine of anatomical wealth, abounding in alcoholics of the rarest of vertebrate forms, in carefully worked out skeletons of all the classes of the animal kingdom possessed of a bony skeleton, in unique types, and in a rich mass of illustrative material for the *Invertebrata*. Fortunate indeed will that institution be that can secure by purchase this great treasure, and I feel sure that American science is with me in the devout hope that it may as a whole be obtained by this country. More than a generation will surely pass by before such another opportunity will be offered our museums to so enrich their collections in departments of such paramount importance, — and yet it needs but a word from some one among the wealthy, or the timely action of our own government, to have all this conveyed to our shores. Think for an instant how the inpouring of that material would swell and fill the gaps in the collections of the United States National Museum. What a living repository of reference would be there for the students in science for ages to come. Let it be hoped that the bare suggestion of the above facts is sufficient for our prompt action to secure for ourselves such a rare treasure as Professor Parker's collection.

DR. R. W. SHUFELDT.

Takoma, D.C., July 7.

AMONG THE PUBLISHERS.

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— An ephemeris for the use of members of the astronomical department of the Brooklyn Institute, July to December, 1891, prepared by the executive committee of the department, has just been issued by the Institute. Garrett P. Serviss, president of the department, says that the purpose of the ephemeris is to present in a convenient and readily accessible form information about variable stars, meteors, occultations, and other phenomena, with the hope that many may be induced to undertake observations which will certainly prove to be interesting to the observers, and cannot fail to be valuable to the department by giving a definite direction to the efforts of its members. The greatest charm of the starry heavens is felt only by those who study them systematically, but for that purpose an observatory, and even a telescope, is not essential. With an opera-glass, and with the naked eye, many of the most interesting phenomena of the sky may be satisfactorily and usefully observed. Arrangements have been made to furnish special information and assistance to observers at the meetings of the department, which will be resumed in October, and in the meantime members are requested to observe, in any way that may suit their convenience, the phenomena to which attention is called in the ephemeris, and to make notes of their observations. The president of the department will be particularly obliged if members will, at their earliest convenience inform him, by letter or otherwise, of their intention to undertake any of the observations recommended. Any request for additional information or advice will meet with prompt attention. It is intended to make the department of astronomy one of the foremost in the Brooklyn Institute, both in the attractiveness of its meetings and in its general influence, and every member who undertakes any of these observations will give material assistance to that end.

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